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Elisha Sterling M.
THE REAL NATURE

OF THE

ELECTRIC FLUID,

Explained and Illustrated by Numerous Facts;

AND ALSO,

A CAUSE ASSIGNED FOR THE

POLARITY OF THE MAGNET.

BY JAMES GLENN.

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P R E F A C E .

THE principal part of the following pages was recently read to Professor CATLIN, Dr. NOYES, and Mr. MILLS, of Hamilton College, being the first time it was ever revealed to any person ; it was also subsequently read to a number of of scientific gentlemen in Utica. It is now respectfully submitted to the decision of a generous and intelligent Public, in the full belief that it is the most rational and plausible Theory that has yet been published, and that it has more facts to support it than any other.

The author is aware that there are some facts difficult to explain, even on his principles ; but he has never met with but one, in the whole course of his reading or conversation, that militates against them ; and that one is contained in a note only, in Prof. LEWIS BECK's Treatise, extracted from Dr. FRANKLIN's work. But that statement is contrary to all the well known facts of the science, namely :—“That active Electricity existing in any substance, tends always to induce the opposite electrical state in the bodies that are near to it ;” and “each pole of a Magnet induces the opposite kind of polarity in that end of the iron which is nearest to it, and the same kind in that which is most remote.” The author repeats, that it is so contrary to these facts, that he did not think it necessary to consider it (although coming from a learned author) as overthrowing any of the principles advanced in this work.

PRATT'S HOLLOW, August, 1840.

PREFACE

The present part of the following paper was written and is published
by the author and Mr. W. H. L. in London, England, in the year 1841.
It is intended to be a paper, and is not a book, and is not
to be read in a library, but in the hands of the public, and is
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LONDON: Printed by W. H. L. in the year 1841.

ELECTRICITY AND MAGNETISM.

IT is a pleasing feature of the present age, that the road to science is open to all mankind, who have the means and inclination to pursue it; and no superstitious enactments interfere to prevent the diligent investigation of the laws of Nature. But although this is the case, there are still some people who would invest some of the operations of Nature with a mystery which they say is presumptuous for any one to attempt to unfold. And there are others, again, who would designate some of the laws of Nature as a peculiar emanation from the Deity, that He never meant should be revealed to mankind. This mode of reasoning is certainly very preposterous, as it may be the means of deterring some people from prosecuting researches, that might have otherwise terminated very successfully. There are no objects or operations of Nature that ought to be considered above the comprehension of man; he ought rather to be encouraged to examine every thing that presents itself, however intricate or awful, and difficulties may at last give way, and discoveries be made of which he had not the least idea. Such has been the case with the two subjects I am now about to discuss. The qualities of the Electric Fluid have been denominated by some, a subject destined to be for ever hid from the gaze of man; and the Magnet has been termed a direct gift from the Deity, without having any positive cause for its directive qualities.

In making known my views regarding the subjects of Electricity and the Polarity of the Magnet, I shall endeavor to be as brief as the nature of the subject will admit, designing at a future opportunity to go a little more into detail.

The first occurrence that directed my attention to Electricity, was the well known circumstance of milk becoming sour during a thunder-storm, although quite new and perfectly sweet but a few minutes previous. This fact led me to consider the Electric fluid as an extremely subtle acid gas, and that during a thunder-storm it is generated by the union of a number of other gases that have exhaled from the earth and collected in the atmosphere during warm weather.* Although I entertained this opinion for a number of years, I did not reflect much about it until very recently, when reading some account in the newspapers of thunder-storms, and the circumstance of Lightning striking some trees more than others, it attracted my attention, and on making minute inquiry of a great number of individuals who had witnessed the effects of Lightning on trees, I learned that

* It is somewhat singular, that although chemists were aware that electricity was produced during the decomposition of matter, it never led them to suppose that it might be generated by the same or similar means in the atmosphere during a thunder-storm—such as the decomposition of different vapors or gases. Although not practically acquainted with the operation of a galvanic battery, we are induced to think that the electric fluid is produced in that operation partly by the decomposition of the metals through the action of the acid; and both metals and the acid give out their natural share of the fluid to the conducting wires. Should this be found to be the case, it will be some proof of our theory that lightning may be produced, and that in this operation art but imitates nature.

it very seldom injured beech and maple, and that its effects were very fatal on pine and hemlock, and that they are the kind most apt to be struck. From these facts I inferred, that as acids and alkalies unite and form neutral salts, and have an affinity for each other, and that as beech and maple contain alkaline salts or potash, this was one reason why the Electric fluid, having an affinity for those substances being an acid, did them but little injury, as it renders them good conductors; while the pine and hemlock, being of a resinous nature, and of course bad conductors, or in other words, substances for which the Lightning has no affinity, are shattered to pieces, and large fragments of the trunk are often thrown to a distance. Oak trees are also very apt to be struck, and I have found on inquiry, that the wood of oak gives but very little ashes, although there are some in the bark of considerable strength.

These facts tended strongly to confirm the definition I had given of the Electric fluid, and my belief was further strengthened by considering other points of resemblance. Carbonic acid gas, although it exists in large quantities in nature, uncombined, is yet produced by fermentation, whether acetous or vinous; and who knows but that the Electric fluid of which we are speaking, may be produced by a similar commotion of the different gases in the atmosphere? The former operation destroys all crude, indigestible matter; rendering liquids wholesome and beneficial as a drink, and nutritious nourishing substances, as wheat flour, palatable and of easy digestion. And the latter process purifies the air, rendering it cool, refreshing and invigorating, after sultry, enervating heat. I do not give these last remarks from a conviction of their certainty, and indeed they may appear to some people too fanciful; they have, however, some appearance of probability,—and if it were the case, it would develop a beautiful system of Nature: that, when the atmosphere we breathe gets so contaminated and corrupted by different exhalations arising from the earth in very warm weather, it is cooled and purified by a process similar to that we cause to be performed in the baking of bread, and without which, the most nourishing substance in nature, wheat flour, would not be fit to eat. And although an agent is exhibited in both cases (when it operates on a large scale,) that is fatal to life—carbonic acid gas and the electric fluid—yet the evil is but partial, while the benefit is universal.

There is another analogous circumstance subsisting between the two substances, acids and electricity; and that is, their penetrating qualities. Acids are the most searching of any other substances that I am aware of; they will corrode or consume almost every thing with which they come in contact; there is hardly any vessels that will contain them, except those made of glass, and they act very readily on iron, forming salts. This similarity between acids and the electric fluid is very striking: for glass is a non-conductor, while iron and all ferruginous bodies are the very reverse. In fact, if the term *affinity* were applied in treating of Electricity, instead of the terms *conductors* and *non-conductors*, or *electrics* and *non-electrics*, it would apply equally as well; although, for all the difference it would make, there is no necessity for changing the terms—the electrics are those for which the fluid has an affinity, and the non-electrics are those for which it has no affinity.

The Electric fluid appears in different states: Lightning is its highest or most accumulated state; that condition of it excited by the galvanic battery and electric machine, is its next; and it exists in all ferruginous bodies, and particularly the load-stone, in the lowest state in which its agency can be exhibited. In all these states, I am convinced that it is one and the same fluid; and there can be no doubt that it exists in a very latent and diffused state all over the atmosphere and in the earth. But this I will explain hereafter, when I come to speak of the Magnet. These different states have been termed the *positive* and the *negative*; but I am inclined to think there is only one natural state of it,—that is, as it exists in the earth and the atmosphere, and in the load-stone; or, to speak more correctly, there is only one natural condition of it—for in the other cases it is the

simple fluid accumulated by natural or artificial means, and cannot, properly speaking, be termed a state of it. In the former case, it is elicited by the friction of the clouds, as electricians say; or in my view of the case, it is generated by the union of different kinds of gases. In the latter case, it is produced by machines or contrivances for that purpose, and some fishes have an internal electric apparatus, that accumulates it for that purpose.

I am aware that philosophers have drawn a distinction between Electricity and Magnetism, and have ascribed them to the agency of two different fluids; but this I am satisfied is a mistaken idea, which I will shortly explain. Although the Electric fluid, in an accumulated state, such as lightning, has a powerful heat—so much so as to fuse metals by merely passing over them instantly,—it is yet in its natural state a cold fluid, it exists in the greatest abundance in cold weather and cold countries, and resides in cold bodies, such as iron.* Its existence in a hot state is only instantaneous, for it explodes and rapidly returns to a cold state; and hence undoubtedly the refreshing coolness that follows a thunder-storm. I know that electricians have said that heat induces electric currents; but I am convinced that this is a mistake, and that they have built a theory on this idea (*Thermo Electrics*) that is entirely false. Heat weakens electric currents, and in hot weather and in warm countries, there is less Electricity than in cold ones. This we consider some foundation for our opinion, that the electric fluid is generated in the atmosphere during a thunder-storm; because it accords more with probability and the economy of Nature, that when the fluid is scarce in warm weather, in the atmosphere, to suppose that more would be generated to make up the deficiency—than to imagine that what little was left for respiration, should go to constitute the thunder-storm. I may remark here, that the friction of bodies elicits electricity, but the fluid does not reside in these bodies; that is, if they are electrics, it is taken from the atmosphere. Of this, we shall have also occasion to remark hereafter.

We will now proceed to state the principal part of our discovery, "which we think will corroborate a great part of what we have already advanced. As the most of the principal actions of mankind are influenced by accident, I will merely state the first cause that directed my attention to the Magnet. In the summer of 1839, I wrote an article "On the Origin of Vapor or Mist," which was published in the "New-York Express;" but upon subsequent reflection, I perceived that it was egregious folly in me to attempt to write any thing about the weather, the results were so uncertain, and the laws which I supposed to regulate the weather not being uniform, and of course not producing uniform results. A severe storm

* We have strong reasons for the supposition that the electric fluid is a cold body in its simple state; yet the igniting effects of a galvanic or electric battery would induce some to think otherwise. We have already had occasion to remark, that in the former case it is produced by chemical means: in the latter, it is the latent current accumulated by three distinct operations. It is accumulated, first, by the electrifying machine, each discharge passing into the Leyden jar; secondly, the jar is an accumulation or concentration of successive discharges: and, thirdly, a number of such jars (twelve) constitute an electric battery, and when discharged all at once, is a third concentration of the fluid. This is a process which we are inclined to think nature never performs; and that no part of the simple fluid ever goes to form lightning in a storm. Its powerful heat, therefore, is produced by chemical or artificial means, and in its natural state is cold. It is with great difficulty that ignition can be produced by an electric machine, if it can be produced by that means at all. We have frequently seen the conducting rod applied to sore, inflamed eyes, which produced a sensation of coolness. Light, or a spark, is not always evidence of heat, for both may be produced in very cold weather by slightly rubbing some substances, or even the back of a cat; and the human body may be charged by a machine so as to emit sparks, without any sensation of heat. We have never heard of ignition being produced by the Aurora Borealis, (which is doubtless a collection of the fluid in an accumulated state), or even destruction of life or any kind of violence by it.

might happen at one time, and might not occur again^f for ten or twenty years. A hurricane might sweep over some devoted village, and such an event might not again take place for an age. A simple peasant knows more about the weather in the district of country in which he resides, than the most acute philosopher could do that ever lived. The generality of people know something about the average kind of weather, but when there occurs an exception, all classes are at fault with their predictions. It was from reasoning in this manner that I concluded to turn my attention to some study that was regular in its operations. It then occurred to me that the Needle, which points to the North with so much regularity, must be governed by an uniform and unvarying law. And notwithstanding it had baffled philosophers for ages, it was yet possible to find it out. I then resolved that I would examine it minutely the first leisure time I had to spare. Time however passed on, until reading an article in Mullinger Higgins' book on Magnetism, I was surprised at finding the following remark: "Poles of the same name repel each other, and opposite ones attract"—and he adds: "It follows that we have misnamed the poles: that which is directed to the north pole of the earth, is the south pole of the magnet." This contradiction in terms amused me; and after reflecting a moment, I at once discovered what I consider to be the real cause of the directive powers of the needle—and it is this:

There is an electric current constantly passing all over the face of the globe, from South to North, and the Needle, possessing naturally a large share of the fluid, lays itself in the direction of the current, and the current passes through it. I at once perceived that this explained all the phenomena attendant on the Magnet, and rendered the whole science of it perfectly simple and easy. I procured the work of Professor Olmsted, of Yale College, and found that every experiment with the Magnet detailed by him, completely verified this idea, a few of which I will now state.

The reason that poles of the same name repel, and opposite ones attract, will now appear obvious; because the currents of electricity entering at the South, and passing out at the North end, oppose each other; that is, they are blowing in opposite directions. If the north or boreal point of the one is reversed and laid against the boreal point of the other, the two currents would be meeting each other, from the habit that the Magnet had acquired—and the one that was reversed would very soon lose its power, or have its poles reversed. Upon the same principle, then, take the South pole of the one and place it against the North pole of the other, or in front of it, and they will attract each other, because the current is then blowing in its natural direction—that is, it is passing out at the boreal point, and entering the austral. "If a Magnet is broken into different pieces, each part will be a perfect magnet of itself, having a South and a North pole." This I consider a strong presumption in favor of the supposition of a current, if not an actual demonstration of it; for it is evident that wherever the current passes out, is its north point, and where it enters, its south point, and this will be the case wherever a fracture is made.

Professor Olmsted favored the doctrine of two fluids in a magnet, (the austral and boreal)—and the fact stated above rather confounded him, for it was natural to suppose, according to his doctrine, that breaking a magnet in the middle, and taking away the austral half, there would only be one south pole. But philosophers do not forego their opinions on such slight grounds, and the Professor accordingly gives the following very inconsistent explanation: "The reason of this is, that the two fluids are in very minute divisions." I have found it to be an invariable result, without a single exception, that where the fluid or current enters into a magnet, it is its south pole, and where it passes out, its north; and this is the case with a negative and a positive pole of a battery, and a good many conducting substances, and even round balls of iron have a tendency to poles, or to direct themselves North and South.*

* We will here give two more examples, omitted in the text, which we think will

Lightning is said to affect the Needle; and when struck by it, it sometimes destroys it, and at other times it reverses its polarity. It also very frequently magnetizes pieces of iron, and the same power that destroys a Needle can also restore it. This seeming contradiction is of easy explanation, upon the principle of a current that we have advanced. The cause of its destroying the powers of a Needle, is doubtless owing to the lightning absorbing in its passage all the natural share of the fluid residing in the Needle; and the reason of its reversing the direction is very probably caused by the lightning passing in an opposite course to the current. But these occurrences are by no means common, as lightning sometimes strikes without doing the Needle any injury; and when it is destroyed, as I have already observed, the same power can restore it, for it has frequently been known to magnetize bars of iron. In these cases, it will always be found (reasoning from analogy) that at the point where the electric fluid entered will be its south end, and where it passed out its north end; and we surmise that this would be the case, whether the electric fluid entered in a contrary direction to the natural current, or whether it passed in a perpendicular course. The bar, on being poised by the middle, would direct its end to the north, where the lightning made its exit; or if the body were a small Needle, it would direct itself on the water, as this element is a cold body and a good conductor: and it proves that the current is stronger in water than in the air, when it has force enough to overcome the resistance of the Needle on the surface of the water. All these statements go to prove that Lightning, Electricity, and Magnetism, are the same fluid, only differing in degree or intensity, and in the qualities or substances of bodies by which they are acted upon.

The Polarity of the Magnet, as it is called, has always been considered as constituting it a distinct fluid from the rest; but this is entirely owing to the habit or nature of iron or loadstone being a good conductor, and at the same time inheriting a considerable natural share of the fluid, which it has doubtless received from the current passing in the earth—as it is possible it passes under as well as over the surface of the globe; but we have not so many facts to support the former assertion as the latter. This then is a peculiar property that iron possesses, and not any distinct quality of the fluid. We have often been surprised that the circumstance of lightning magnetizing iron bars, or a shock from an electric machine, or a discharge from a Leyden jar, was not considered by philosophers as a sufficient evidence of the identity of the fluid. It would appear from these examples, that magnetizing is neither more nor less than the passage of the electric fluid in an accumulated state through the iron,—(this alludes only to the circumstance of lightning or electricity magnetizing,)—and that the current of electricity being in a more diffused simple state, follows in the track that had been prepared for it. Lightning always darts straight forward, except when meeting with a non-conductor, when it shatters it to pieces, or takes a different direction—but never retraces its track. In order to make ourselves perfectly understood on this point, we shall suppose that the electric fluid, or lightning, magnetizes a bar of iron, by passing through or over it from north to south. If this bar is taken and poised by the middle, it would reverse its position; the friction of the earth rendering the current unable to do this before. But suppose the bar to be left for some time in the same state in which it was magnetized, it would either lose its proper-

verify the rule there stated. "If the north pole of a magnetic bar be placed upon the middle of an iron bar, the two ends of the latter will have north polarity, while the part of the bar immediately in contact with the magnet receives south polarity; and if the same north pole be placed on the centre of a circular piece of iron, all parts of the circumference will be endued with north polarity, while the plate will have a south pole in the centre." See further examples in Professor Olmsted's work. In the cases here stated, where the current enters, is its south point, and where it passes out (although at the two ends of a bar, or through the whole circumference of a circle or star) is its north part.

ties as a magnet, or have its poles reversed; and this would be effected by the natural current forcing its way through the bar in a contrary direction to the passage of the lightning. It would seem that magnetising is merely the passage of the fluid in a slightly accumulated state through the iron, making a path, as it were, for the fluid in its more diffused and simple state to pass, and this is probably effected by giving the grain of the metal a slight tendency that way. But these remarks only refer to magnetizing by lightning, or electrifying apparatus.

One Magnet, it is well known, will also impart the property to another, or even to a hundred, and be stronger than it was before. Philosophers could never explain this, as it differed from their theories of communication, and they considered this principle as constituting Magnetism a distinct principle from Electricity. But the cause of this will now appear perfectly obvious. The Magnet, as we have already stated, possesses a natural share of the fluid, in a higher accumulated state than the simple current, though not so much as that produced by an electric machine, and when an unmagnetized piece of iron is brought near it, the natural current is diverted from its direction, and both the Magnet and the iron attract each other until they come in contact. While thus adhering, or placed along side each other, the natural current is passing through the Magnet—entering the iron at one end, passing out at the other, and re-entering the Magnet at the other. It thus acquires an accumulation of the fluid that the Magnet possessed, and also its directive qualities; and on being taken apart it will reverse its position, according to the principle I have already given. The Magnet in this case does not part with any quantity of its properties; if it does, it is instantly supplied from the current, in the same way that it originally received it; and of course it may impart the quality to a hundred, when it has the power to renew itself and be stronger than it was before. Its increase of strength may be explained upon the principle that habit and use increase the capacity of objects, or even men and animals, to a certain point.

This example explains two other experiments with the Magnet, that have puzzled philosophers. If a Magnet is left in an unnatural position, its boreal point towards the south, it will soon lose its directive qualities. But if two Magnets are laid along side of each other, with their dissimilar ends united, they will retain their properties;—this is in consequence of the current passing through both Magnets—first into the one and then into the other, as if it were a circle,—as I have hinted above. Philosophers explained these two examples, by saying that “the single Magnet lost its power, by lying contrary to the magnetism of the earth; and the two Magnets being together, neutralized each other’s properties, and prevented the loss of power.” I am inclined to think, although not conversant with the operations of a galvanic battery or electric pile, that the principle illustrated above with the two Magnets,—the fluid passing out of the one into the other, and being retained in that manner some time, and still receiving a supply from the natural current,—explains the great secret of the amazing power of the Horse Shoe Magnet. The fluid being retained in it, and also retained in the great quantities of wire by which it is surrounded, and being still capable of absorbing more from the natural current in proportion as its capacity is urged or drawn upon by additional weights. It may be objected here by some, that this peculiarity in the current passing through the two Magnets, does not accord with a remark that has been made about lightning, which it was asserted never retraced its course. Although this is contrary to its nature, yet there is a probability that it may run round a circle, or, what is much the same thing, pass through one bar of iron into another that is lying along side of it. But the existence of the lightning in this highly accumulated state is only momentary, for it soon disperses, and quickly returns to a latent state.

We shall now explain here a remark that has been already made: that “Electricity does not reside in electrics, but that it is taken from the atmosphere by friction.” In all probability this is accomplished by the substances rubbed ar-

resting the current of electricity, until they become enveloped with it, as is found to be the case in an electric machine. It remains in this state for some time, or until a conducting substance, such as iron, is applied to it, when it passes off. Chemists and natural philosophers have considered this circumstance as establishing a difference between Electricity and Magnetism. But in fact, as we have already observed, the difference is only in the bodies and in the condition of the fluid, the latter being in a higher accumulated state. There can be no doubt that the natural current of electricity which I have supposed to exist, constantly passing from south to north, passes through all objects, electrics and non-electrics, with equal facility in this rare diffused state. But when two bodies are violently rubbed, the current is concentrated and accumulated around the object, such as the glass cylinder of a machine; and this being a non-conductor, it cannot pass through it in this state, but remains in it only a short time, when it passes off of its own accord, unless a conducting substance is applied to it. Non-conducting substances, then, do not retain or inherit a natural or accumulated share of the fluid, while magnetized substances do; and this constitutes the real difference between the two kinds of bodies.—And I am induced to think that all conducting substances retain a small share of the fluid. This remark may appear very inconsistent to some people, as they may naturally inquire why it is that the conducting substances do not conduct it all off? In answer to this we would observe, that it is natural to suppose that a body having an affinity for another substance, would retain a portion of that substance, even although it afforded a ready passage for the most of it through it; for it is not to be supposed that a body would allow the free passage of another through it, for which it had a great affinity, and not retain a single quality of the passing substance.

These remarks will further illustrate the case of the Magnet and the Electric Fluid. The latent current, in passing through the magnetized iron, it is natural to suppose will have a tendency rather to increase its power than to diminish it; and it is equally plausible to suppose that the passage of the fluid in a highly accumulated state through it, would deprive it of all its qualities by absorbing all there were in it; and it also follows, from both these conclusions, that the passage of the fluid in an accumulated state through the iron, would also magnetize it.

It may be a subject of inquiry by some persons, what becomes of all this Electricity that is constantly passing over the face of the earth towards the north. This may be a difficult question to solve; it may return through the crust of the earth to the south, thus again to continue its perpetual round,—or it may be converted by some operation of nature into another element, and return in the same way, to be resolved again into its former fluid. These last remarks, however, are only given as mere conjectures, which any person is at liberty to accept or reject, as may best accord with his judgment. There are always some ultimate causes that we can hardly hope to explain. The dip of the Needle towards the north would seem to indicate that the current has a tendency downwards, and its getting almost vertical there, gives a strong coloring to the above supposition; while towards the extreme south the Needle rises in proportion as it is depressed towards the north, which would seem to indicate that the current there rises; these are all the arguments I have to support the above supposition. However this may be the case, there are good reasons for believing that Electricity is much more abundant in the northern regions than any where else; and that the *Aurora Borealis* is nothing else than Electricity having accumulated there in great abundance, in consequence of the current setting in that direction.

Another question will naturally arise here in the minds of many,—why is it that the thunder is not produced in consequence of the great accumulation of the electric fluid in that region? This is a question that we hope to be able satisfactorily to answer; and we consider it of some importance, as it will tend strongly to confirm the statement we have twice already made, viz: that lightning is generated, and that only in warm countries, or in hot weather, and that no part of

the electricity in the atmosphere is taken to form it. We have never heard or read of a single instance of a thunder-storm occurring in what is called the Polar Regions; and if such a circumstance never occurs where there is such an abundance of electricity in the atmosphere, then it is conclusive evidence that the amount of electricity in the atmosphere does not go to form the thunder-storm, but that it is produced by the collection, and consequent commotion, of various kinds of vapors or gases in the atmosphere. A thunder-storm most generally occurs in warm weather, and it is admitted by philosophers, that there is less electricity in the air at such a time than any other, and that an electric machine is much more difficult to charge than in cold weather. If, then, it is more difficult to charge a machine by excitation, what must it be for the clouds to excite it, as they suppose, by friction, during excessive warm weather. But the idea of an electric fluid or vapor, of which a cloud is composed, being rubbed or excited, is quite contrary to all our experience or preconceived notions of substances; for it requires a hard solid substance to accomplish this. The idea of two portions of water being rubbed together is quite ridiculous, at least in our present state of knowledge; and it is certainly a much heavier fluid than any portion of a cloud. The most probable conclusion, then, is that it is produced, as I have already stated, by the union of different gases exhaling from the earth; and there are some circumstances of frequent occurrence that tend to confirm this view of the subject. Earthquakes and volcanic eruptions are attended by thunder, and sometimes only by lightning. But in most cases a low dense black cloud appears above the spot where the action is taking place, from which proceed vivid flashes of lightning. Now is it not likely that this cloud is a collection of gases proceeding from the crater of the volcano, or is emitted invisibly from the earth, previous to an earthquake, or during its continuance? These clouds appear composed of one mass, and do not form separate volumes, and besides they have a settled appearance,—and do not seem to move, so as to give an idea of friction. We all know the powerful and strange effects produced chemically by the union of hydrogen and oxygen gases; and what may not be expected from a cloud, formed by the union of all kinds of noxious gases, hydrogen, carbonic acid gas, and sulphureous emissions from the bowels of the earth? I am well aware that it is dangerous to prosecute experiments with the electric machine during a thunder-storm; but this may be owing to the electric fluid being shot forth in streaks through the air during the process of production. The natural current does not seem to be affected, or only occasionally, by the storm, for the Needle preserves its direction, and the circumstance of its being injured is only accidental and of rare occurrence. This is some proof that the natural quantity of electricity in the atmosphere forms no part of the thunder-storm.

But there are still other arguments and analogous circumstances to prove that lightning is generated by the union of other fluids; for we consider the establishment of this principle of some importance. It has already been stated that heat weakens electric currents, and the act of holding a heated object over the Needle induces it to deviate from its direction. This may account in some measure for the variation of the Needle in warm climates, or it may be that the current may veer a little east and west, owing to some natural causes, and the intensity of the current may have the same effect in cold countries. But the agent or fluid being more intense in cold than in warm countries, evidently shows that it is a cold fluid, and that excessive heat lessens it; that it is a law of nature, established by an overruling Providence, that it should be supplied in warm countries to cool and purify the air rendered unhealthy by pestilential vapors, and that its agency in effecting this is very considerable. But if it is not produced by gases exhaling from the earth, where originates all the electricity that constitutes the severe and very frequent thunder-storms in hot climates? Philosophers do indeed say that it is excited by the friction of the clouds; but as I have already stated, the fluid does not reside in the bodies that are rubbed, if they are electrics,

and of course if the clouds are charged, as they seem to be, without any collision, this operation is certainly not the cause of the appearance of the fluid. It is then, we think, quite reasonable to suppose, that as electricity is very scarce in warm weather, a thunder-storm is an effort of Nature to supply the deficiency; that, as in these seasons of extreme heat, more noxious vapors are produced, it is from this source that it is principally supplied; and that Nature, in thus acting, accomplishes two very beneficial purposes, by destroying pestilential exhalations, and by imparting a cooling and refreshing influence to the air we breathe.

Some people who are not conversant with the principles of electricity, will hardly conceive it possible that there exists in nature a fluid so subtle as to be capable of passing through all objects in existence, when in its simplest state, and to be incapable of being dissipated or impaired by wind, rain, hail, snow, or any agent in nature with which we are acquainted, excepting excessive heat; and it is equal in velocity to light itself, and infinitely more rare,—for light cannot penetrate thick, close objects, excepting vitrified substances,—and perhaps it is the most subtle fluid in Nature. Such people may have their doubts lessened on this subject, by considering that a shock from an electric machine has been known to pass through very many objects the distance of four miles, without any perceptible interval of time; and in all probability it might pass through the earth, from one end to the other, in one second of time. The Aurora Borealis may be taken as a specimen of its motions, which is doubtless the fluid in an accumulated state. The rarity of electricity will not surprise chemists, for they get acquainted with invisible substances. Hydrogen gas is invisible, and is fourteen times lighter than common air. There are even some liquids that are invisible: muriatic acid, if pure, cannot be perceived by the naked eye, even in an impure state,—and we have frequently not been able to perceive it on pouring it out of a bottle. From a consideration of these facts, the rarity of the electric fluid will cease to be an object of wonder; but it is probable that its velocity is not so great in its simple natural state as when it is accumulated, for the rapidity of its motions may be owing to its haste to return to its natural state; as we find that all acids, and some other substances, are more quick in their motions when concentrated, and more difficult to be retained, than when reduced and simplified.

We have remarked above, that heat impairs or weakens the electric fluid, and it is the only agent that we are aware of that has this effect upon it. Extreme heat impairs and extreme heat is the means of producing it. This would appear surprising, were it not a well known fact that in many other instances extremes very often produce opposite results. It was the ignorance of the effect of heat on the electric fluid that led philosophers into many errors and erroneous theories concerning it. By supposing that it induced electric currents, while it was actually destroying or impairing them, they have built a theory of *Thermo-Electricity* that has no foundation in truth. They have supposed the earth to be a vast thermo-electrical apparatus, with unequal currents of electricity of different intensity running in every direction through it; and in this way they attempt to account for the variation of the Needle; while in fact if this were the case there would be no regularity to the Needle at all, and it would be quite useless. But this idea of heat was another stumbling-block in their way in accounting for a thunder-storm. Although they were well aware that there was less electricity in the air during warm weather than at any other time, yet they contrived to make it appear that there was considerable in the air just previous to the storm, in order that electricity might be taken as the cause of lightning. Hence arose the difficulty in accounting for thunder-storms in very hot climates.

Although I have endeavored to prove that the electric fluid is a subtle acid, yet it is only in its accumulated state that its properties of this kind can be traced. It could not be expected that in its simple and diffused state, its acid properties would be perceptible to our gross senses. All acids are cold, and bodies containing them are generally so; and this is a striking property of the fluid, for it is sta-

ted that the magnet improves with every degree of cold that has yet been applied to it, except perhaps some degrees below zero. Chemists have considered oxygen as the principal agent in supplying acidity; but we think it may with greater probability be assigned to electricity, and that the great abundance of acid fruits (such as the apple, the plumb, the cherry, and a variety of currants, gooseberries, &c. &c.) in temperate climates, is supplied from this source. Owing to their qualities of coolness and acidity, they are excellent antiseptics. Electricity is therefore in all probability a powerful antiseptic, and exerts a salutary influence in preventing fevers in mild climates. Perhaps the marsh miasmata is induced by stagnant water, being deprived of a considerable share of its electricity by excessive heat, and the effluvia arising from it inhaled by the human system without this correcting principle. It may likewise be that the great prevalence of fevers in hot climates is owing to the deficiency of the fluid under discussion. But aware of the great tendency of mankind to fanciful speculations, we shall not extend this subject any further at present, but conclude this part of our treatise by repeating the principles which we think we have established:

First. We have made the following subjects appear very probable by acknowledged facts, viz: That the electric fluid is a very subtle acid gas; that it is generated in the atmosphere during a thunder-storm; that the friction of bodies does not produce electricity; that it is merely the electric current arrested and accumulated by that mechanical operation; that electricity and magnetism are owing to the same cause, the only difference consisting in the nature of the bodies by which the fluid is acted upon; that electricity is a cold substance, and that cold increases its strength, and heat impairs it.

Secondly. We think we have fully established the following principles, at least as far as this can be done by any means short of actual demonstration, viz: That there is a latent current of electricity constantly passing over the whole face of the earth, from south to north, and that the needle or loadstone, possessing a natural share of this fluid in a more accumulated state, lays itself in the direction of the current, which is the cause of its directive qualities; and that its poles or ends are owing to the entering and passing out of the fluid—that end where it enters being invariably its south end, and where it passes out, its north. It follows from this, that the theory of the earth being a magnet with poles at each end, is a mere chimera of the imagination, and has no foundation in reality—a subject on which we will make a few remarks in the next chapter.

TERRESTRIAL MAGNETISM.

It is a remarkable circumstance, that although philosophers have entertained the opinion for several hundred years that the earth is a magnet with two poles, yet they could never form a consistent hypothesis concerning it, and often contradicted themselves in the very terms that they used,—that is, when it was given, as explaining the phenomena of the directive powers of the magnet. We will take the liberty in this place of indulging in a few remarks concerning their various conjectures on this subject, as it will be some gratification to us for the torrents of abuse with which (when very young) we were assailed for what was termed our hardihood in presuming to oppose the systems of learned philosophers—as we were always very sceptical concerning these subjects.

We are not certain, but we believe it was Gilbert, an English philosopher, with whom the idea originated “that the earth is a magnet, and that the polarity of the needle was due to the magnetism of the earth.” The word *due* is rather a vague way of accounting for the connection between the earth and the needle; for the latter is elevated above the former, and some relation ought to have been made to appear. But there was another incongruity which the philosopher was aware of, and which he endeavored to explain, viz: “Poles of the same name repel each

other, and opposite ones attract;" and, of course, the end that points to the north could not be attracted by the north pole of the earth. The philosopher explained this contradiction by substituting another—"The pole of the magnet (he says) that points to the north pole is its south pole, and the one that points to the south is its north pole." This is not giving to things names significant of their natures, but entirely the reverse. But notwithstanding all these incongruities, this supposition has been adhered to until the present day. And a late author, Mullinger Higgins, Professor of Natural Philosophy in Gray's Hospital, England, who wrote in 1837, feelingly laments that justice has not been done to the name of Gilbert, for that, among other things, he had accurately designated the names of the poles.

But the location of the poles at the ends of the earth soon became an object of learned disquisition. One philosophic person would display great talent and profound erudition in locating the pole at one place, while another would soon afterwards exhibit great tact and ingenuity in displacing it, and at the same time give clear and cogent reasons for locating it somewhere else. Others again imagined that the poles were under the earth, while others believed them to be above; and in this way some wise head would rob another of his halo of glory: yet they all contrived to come in for a share of immortality—the only reward which many of them received for their trouble. But amidst all these conflicting opinions, a great philosopher, M. BEOT, comes to the solution of the difficulty. Professor KRAFT, of St. Petersburg, also undertakes the same examination; and while the whole philosophical world was on tiptoe to hear the result of their profound calculations, out they come with their conclusions! which were, "that they both had arrived at the same law, proving the inaccuracy of the first supposition"—not that they had discovered the true situation of the poles, but that it was inaccurate to suppose that they were on or near to the surface of the earth, and for aught that they knew, the poles might be dancing about in the atmosphere along with the *Aurora Borealis*!!!

The variation of the Needle was another difficult subject to account for with learned men; and after various conjectures concerning the cause, they at last agreed that it was owing to there being four poles in the earth—two at each end; and that the variation was owing to the Needle being attracted, first by one pole and then by the other alternately. Several extensive journeys were made for the very purpose of locating these poles; and sometimes one wise man, regardless of what another had done, would establish his pole until they sometimes would have half a dozen. Professor HANSTEEN, of Christiana, undertook a journey into Siberia, at the expense of the King of Sweden, for the purpose of searching for a pole. It was not to be expected that the Professor would undertake so long a journey without coming to any result; and accordingly he established a magnetic pole to the north of Siberia; thus acquiring for himself great celebrity for his profound learning, and establishing for his master a character of great liberality and devotion to the sciences. It is very remarkable that while philosophers were establishing so many poles, they paid no regard to reason, analogy, or consistency, in accounting for them, for they still adhered to their former supposition that the earth is a magnet. If, then, it was difficult to account for several circumstances and incongruities that occurred with two poles, what must it be where there were four, and when in fact all resemblance to a natural magnet was entirely lost; for there could not possibly be four poles to one magnet. There are indeed frequently in a long magnet several sets of poles, or consecutive poles; but that there should be two at each end is quite ridiculous, and at any rate it does not account for the variation of the Needle. The magnet, it is said, in different places in the world declines a little to the west, and after a while returns to its former position and declines to the east. Now if this were owing to two poles near the end of the earth, the one a little to the west and the other to the east, how could the Needle return after it was once attracted by one pole? It would certainly always remain towards the nearest, because the other would have less influence over it, if distance diminishes the attraction, as is found to be the case in all natu-

ral magnets. But there is so much incongruity apparent in these suppositions, that we wonder how any sane person could for a moment sustain them.

There is a theory assumed by Aumpere, that a magnet consists of an infinite number of circular currents of electricity, and which, after a long and tedious explanation, he gives as the cause of the polarity of the needle. We candidly confess that we have never been able to understand the principles he assumes, nor the reason of the results he arrives at in consequence of his assumptions, a diagram of which is given in Lewis Beck's treatise. We are aware of the remark, "that ignorant people condemn what they cannot understand." But we beg to be pardoned for saying, that when a man assumes a theory that requires a great deal of learned explanation and tedious disquisition to make it appear correct, the presumption is that something is wrong about it; but people believe it because it may have some resemblance to truth, and because they are unwilling to confess their ignorance. In this respect, these theories resemble the tiny idols, or relics, which are hung up in some places of worship: too near an inspection would dispel the illusion, and they are placed at a respectful distance that their appearance may inspire veneration.

Being desirous of submitting the discovery detailed in the first part of this pamphlet to the decision of some scientific persons, we called at a learned institution for that purpose. We were informed by an individual who introduced us, that one of the Professors had published a paper in Silliman's Journal, setting forth, among other things, that "the polarity of the magnet was owing to a ball of fire forty-five miles under the earth, which had an influence on the needle; and when the ball of fire vibrated, the needle vibrated." This did not inspire us with a very favorable opinion of the learned gentleman. Notwithstanding, the circumstance might not be true, as we had only the assurance of one individual for it; but however this might be, it resembles many of the conjectures of philosophers, who certainly deserve to have the paradoxical sentiment applied to them, that "wise men are occasionally the greatest fools that ever existed." We called on the Professor alluded to, and after entering into conversation with him, he cited the theory of Aumpere mentioned above, coupled with another theory equally intricate, which he thought contradicted our theory, and he dogmatically insisted (although he did not seem to understand it himself) that it completely refuted all our system.

In this connection, the celebrated theory of Captain Symmes's Hole deserves consideration; but our limits forbid more than this brief mention of it.

Taking our leave of philosophers, we will add a few remarks relative to our own system. This great mystery that attaches to the end of the earth, and deranges the directive powers of the Needle, causing it to dip and become almost vertical, is, in our opinion, nothing more than a turn or shift that the current of electricity takes there; or it may be that it is in the act of resolving itself into another element. The dip of the Needle, and the circumstance of its getting almost vertical at the extreme north, would seem to give some ground for the hypothesis that the current goes downward into the earth to a great depth, and returns to the south, where it causes the Needle to rise in proportion as it is depressed to the north. These two facts—the depression and rise of the magnet—are strong evidence in support of the supposition that the current descends and returns through the crust of the earth to the south; while the supposition that it resolves itself into another element, and returns over the face of the earth in this state to the south, again to be converted into its original fluid, has no fact that we are aware of to sustain it. Some people may naturally inquire, what element it could be converted into? This we cannot pretend to conjecture, as electricity is the rarest fluid yet known, and may yet be proved to be the most subtle fluid in nature. There will always be a first cause that we cannot hope to explain; and could we point to another substance besides this, the inquiry would again be, what became of that? until in this manner we would be referred to the Deity himself, the great Originator of all things.